

World Health Organization
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EXPERT COMMITTEE ON
INSECTICIDES

Report on the First Session

WORLD HEALTH ORGANIZATION
PALAIS DES NATIONS
GENEVA

OCTOBER 1950

Price : 2s 3d \$0.30

The World Health Organization (WHO) is a specialized agency of the United Nations and represents the culmination of efforts to establish a single inter-governmental health agency. As such, it inherits the functions of antecedent organizations such as the Office International d'Hygiène Publique, the Health Organization of the League of Nations, and the Health Division of UNRRA.

WHO had its origin in the proposal made at the United Nations Conference held in San Francisco in 1945 that a specialized agency be created to deal with all matters relating to health. In 1946, representatives of 61 governments met at the International Health Conference, New York, drafted and signed the WHO Constitution, and established an Interim Commission to serve until the Constitution could be ratified by 26 Member States of the United Nations. The Constitution came into force on 7 April 1948, the first World Health Assembly met in Geneva in June 1948, and on 1 September 1948 the permanent Organization was established.

The work of the Organization is carried out by three organs: the World Health Assembly, the supreme authority, to which all Member States send delegates; the Executive Board, the executive organ of the Health Assembly, consisting of 18 persons designated by as many Member States; and a Secretariat under the Director-General.

The scope of WHO's interests and activities exceeds that of any previous international health organization and includes, in addition to major projects relating to malaria, tuberculosis, venereal diseases, maternal and child health, nutrition, and environmental sanitation, special programmes on public-health administration, epidemic diseases, mental health, professional and technical training, and other public-health subjects. It is also continuing work begun by earlier organizations on biological standardization, unification of pharmacopoeias, addiction-producing drugs, health statistics, international sanitary regulations, and the collection and dissemination of technical information, including epidemiological statistics.

Expert committees are an essential part of the machinery of WHO and their function is to give technical advice to the Organization. Members of such committees are "appointed by the Director-General, in accordance with regulations established by the Executive Board". They are chosen for their "abilities and technical experience", due regard being paid to "adequate geographical distribution". Publication of reports of expert committees is authorized by the World Health Assembly or by the Executive Board.



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**EXPERT COMMITTEE ON
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Cagliari, 10–15 May 1949

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WORLD HEALTH ORGANIZATION

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GENEVA

OCTOBER 1950

EXPERT COMMITTEE ON INSECTICIDES

First Session

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The report on the first session of this committee was originally issued in mimeographed form as document WHO/Insecticides/5, 30 May 1949.

* Indicates members unable to attend.

EXPERT COMMITTEE ON INSECTICIDES

Report on the First Session¹

The Expert Committee on Insecticides met at Cagliari, Italy, from 10 to 15 May 1949. By decision of the Director-General, Cagliari, Sardinia, was chosen as the site of the session. This choice afforded members the opportunity of gaining first-hand knowledge of the work being carried out in Sardinia under the joint auspices of the Italian Government and the Rockefeller Foundation (ERLAAS)² in freeing the island from anopheline vectors of malaria by means of insecticides. The committee was, in addition, able to study the measures developed for preventing the reinfestation of the island from sea or air.

1. Terms of Reference

The terms of reference³ of the committee were the following :

(1) To advise the Expert Committee on Malaria regarding specifications of :

international standards for insecticides and their formulations for use against vectors of the disease ;

standard spraying equipment for malaria control and its adaptability to regional conditions ;

¹ The Second World Health Assembly adopted the following resolution (WHA2.18) :
The Second World Health Assembly

(1) NOTES the report of the Expert Committee on Insecticides on its first session ; and
Considering that the report contains technical information and advice for the Expert Committee on Malaria and the Expert Committee on International Epidemiology and Quarantine,

(2) REFERS this report to the above-mentioned expert committees, together with the observations contained in the summary records relating to the discussions on the subject ;

(*Off. Rec. World Hlth Org.* 21, 23)

² Ente Regionale per la Lotta Anti Anofelica in Sardegna : a regional organization for anopheline control in Sardinia.

³ See *Off. Rec. World Hlth Org.* 13, 304.

(2) To draw up a standard method of disinsection of ships and aircraft, to be submitted to the WHO Expert Committee on International Epidemiology and Quarantine for consideration in the drafting of WHO sanitary regulations ;

(3) To make recommendations concerning measures that might be given general application for the prevention of introduction of anophelines into areas free or freed from them.

2. Election of Chairman

The committee elected as its chairman for the session Dr J. Duguet, and as its Vice-Chairman, Dr R. A. E. Galley.

3. Agenda

The committee's agenda was adopted without change.

In addition to its debates, the committee devoted a full day (12 May 1949) to field demonstrations, organized by ERLAAS, of disinsection applied to malaria vector-species eradication and to quarantine measures in aeroplanes and ships.

4. Specifications for Insecticides

4.1 DDT

DDT has been bought in bulk by the British and US armies, and specifications governing the supply of this insecticide to these services have been drawn up by the respective governments. As more was learnt about the manufacture of this compound, it was possible to tighten up the specification in both countries, with the result that the quality now demanded (and available) is much higher than it was a few years ago. The US and UK specifications were used as a basis in the preparation of the following draft specification, which was accepted by the committee, for technical DDT :

4.1.1 *Material*

The material shall comprise essentially 2, 2-bis-(*p*-chlorophenyl) 1, 1, 1-trichloroethane in the form of a free-flowing, white or cream-coloured, fine to medium granular powder, free from extraneous impurity and added modifying agents.

4.1.2 *Chemical and physical requirements*

The material must comply with the following chemical and physical requirements :

4.1.2.1 Setting point : The setting point of the material, determined by the method described in Annex 1, section 1, shall not be lower than 89° C.

4.1.2.2 Total organic chlorine content : The organic chlorine content, determined by the method described in Annex 1, section 2, shall not be greater than 51% by weight.

4.1.2.3 Hydrolysable chlorine content : The hydrolysable chlorine content, determined by the method described in Annex 1, section 3, shall not be less than 9.5% nor greater than 11.5% by weight.

4.1.2.4 Ash content : The ash content, determined by the method described in Annex 1, section 4, shall not exceed 0.5% by weight.

4.1.2.5 pH by distillation : The pH by distillation, determined by the method described in Annex 1, section 5, shall not be lower than 4.5 or higher than 8.0.

4.1.2.6 pH by extraction : The pH by extraction, determined by the method described in Annex 1, section 6, shall not be lower than 5.0 nor higher than 8.0.

4.1.2.7 Water-insoluble, steam-volatile matter : The water-insoluble, steam-volatile matter, determined by the method described in Annex 1, section 7, shall not exceed 0.5 ml./100 g.

4.1.2.8 Chloral hydrate content : The chloral hydrate content, determined by the method described in Annex 1, section 8, shall not exceed 0.025% by weight.

4.1.2.9 Water-soluble matter : The water-soluble matter, determined by the method described in Annex 1, section 9, shall not be greater than 0.25% by weight.

4.1.2.10 Solid matter insoluble in cyclohexanone or white spirit : The amount of solid matter insoluble in cyclohexanone or white spirit must not exceed 1% ; and the water-soluble alkali content of the insoluble residue, calculated as sodium carbonate (Na_2CO_3), must not exceed 0.5% of the sample, the value being determined by the methods described in Annex 1, section 10.

4.1.2.11 *p,p'*-isomer content : The *p,p'*-isomer content, determined by the method described in Annex 1, section 11, shall not be less than 70% by weight ; and the melting point of the separated isomer shall not be less than 104° C.

4.1.3 Packing and marking of the packages

The DDT, technical grade, must be packed in sound clean kegs or other approved packages, as specified in the order, and must be clearly marked "DDT, Technical". The *p,p'*-isomer content must be clearly stencilled on the package.

4.2 Nomenclature of insecticides

The committee recommended, in order to avoid confusion among the various names for a given insecticide, that the following nomenclature be adhered to in preference to trade names or other synonyms:

<i>Name recommended</i>	<i>Synonyms</i>	<i>Trade names</i>
DDT (dichloro-diphenyl-trichloroethane)	—	Gesarol, Neocid, ENB-A, SBL Y
BHC (benzene-hexachloride)	666	Gammexane
Chlordan	—	Velsicol 1068, Octa-Klor
Toxaphene	Chlorinated camphene 3956, Hercules 3956	
Parathion	E 605	Thiophos

4.3 Specifications for insecticides other than DDT

4.3.1 Present knowledge does not allow the drafting of specifications for insecticides, with the exception of DDT, technical grade. Recourse might be had, however, to biological assay, as developed for the γ -isomer of benzene-hexachloride, for the determination of the content of active constituent in the insecticide. In such a case an authentic sample of the pure material must be available, and the unknown samples should be compared with it.

It is further pointed out that international work is now in progress on the analysis of pyrethrum flowers for their content of pyrethrins, and such work will soon supply data of basic importance for the establishment of international specifications.

4.3.2 The committee recommended that WHO obtain all available information on the chemistry of BHC, chlordan, toxaphene, piperonyl butoxide, parathion, pyrethrum, and of other insecticides extensively applied for the control of insect-borne diseases. It further recommended that WHO stimulate and sponsor investigations on such subjects if available information is not adequate for the drafting of international specifications.

4.4 Labelling of insecticides⁴

The committee expressed the wish that the World Health Assembly recommend to all governments that manufacturers of insecticides or of insecticide formulations label correctly the contents of their products in active ingredients, with the possible exception of countries where the relevant national authorities have developed a machinery for testing a product for its efficacy for a specific purpose and have approved the product for this purpose.

4.5 Formulations of insecticides

The committee considered that so many formulations would be required that, even if all the technical data were available, it would probably not be advisable to specify individually all the possible formulations. It took the view that the better course would be to draw attention to points which should not be overlooked by intending purchasers when placing orders for the materials required.

Some of these points are common to all types of formulations ; others are applicable only to one. It may be necessary, before purchase, for methods of analysis to be agreed upon between purchaser and supplier, as it is clearly impossible for all these to be laid down in advance.

The following are the general requirements which should be specified :

4.5.1 *Ingredients*

The ingredients used in the preparation of the formulation must comply with the requirements of the current approved specifications for those ingredients.

4.5.2 *The final product (formulations)*

The final product must comply with the following requirements :

4.5.2.1 Extraneous impurities : The formulation must be free from extraneous impurities.

⁴ The Second World Health Assembly adopted the following resolution (WHA2.18) :
The Second World Health Assembly . . .

(4) RECOMMENDS to all governments that they require from manufacturers of insecticidal products the correct labelling of such products as regards their content in active ingredients. Such requirement need not, however, be imposed in those countries where the national authorities have developed a machinery whereby insecticidal products are tested for efficacy for specific purposes and are officially "approved" for the said purposes.

(*Off. Rec. World Hlth Org.* 21, 23)

4.5.2.2 pH of the diluted formulation or its aqueous extract : The pH of the diluted formulation, or its aqueous extract, shall not be lower than 5.0 nor higher than 8.0.

4.5.2.3 Flash point : The flash point of the formulation shall not be less than 60° C.

4.5.2.4 Corrosion test : The formulation shall not cause staining on prepared metal strips (usually copper or iron, or both).

In addition to these basic requirements, other properties, depending on the use to which the formulation is to be put, must also be specified. For example, for special purposes one or more of the following requirements may be necessary :

4.5.2.5 Freedom from staining properties on fabrics, furnishings, buildings interiors, etc.

4.5.2.6 Freedom from undesirable residual odour.

4.5.2.7 Freedom from effect on plastics (perspex, plexiglass).

Properties 4.5.2.5 and 4.5.2.6 are desirable in formulations for use within domestic premises, whereas in farm buildings they are probably not important. Property 4.5.2.7 becomes important, as a rule, only if use in aircraft is envisaged.

4.5.2.8 Another aspect which must not be overlooked is that of the crystallization of insecticides from solutions and emulsion concentrates at low temperatures. Consideration should therefore be given to the lowest temperatures likely to be encountered in local storage and provision made for heating the stores if necessary. If this is impossible, the amount of insecticide should be reduced to such a level that crystallization does not occur.

4.5.2.9 When emulsions and wettable (dispersible) powders are required, consideration must be given to the type of water (hardness, salinity) which will be used for their dilution. It is clearly unnecessary to have a concentrate which will withstand dilution with sea-water if ample supplies of soft water are available. In ordering emulsion concentrates and wettable powders, the duration required, in hours, of the diluted (stable) emulsion or the diluted (suspended) powder should be quoted.

4.5.2.10 Neither the insecticide nor the final formulation when used for indoor treatment of premises must be such that a toxicity hazard to man or domestic animals is involved in their normal use.

4.5.3 *Packing and marking of packages*

The formulation must be packed in sound, clean drums or other approved packages, as specified in the order, and must be clearly marked

with the name of the formulation and with the content of active ingredient, e.g., chlordan, emulsion concentrate, 25% technical chlordan.

4.6 Information on insecticides

The committee recommended that WHO be prepared to furnish on request to health administrations information on insecticide specifications, having recourse, if needed, to members of the insecticides panel and to other sources and, if necessary, arranging to have the product analysed in the country of origin or elsewhere.

5. Specifications for Sprayers

5.1 Specification for compression sprayers

In drawing up the following draft specifications, the committee had in mind the commercial types already available. The committee was of the opinion that such draft specifications could be regarded as basic, for use in any area. It was realized that it might not be possible to find in any one model all the recommended requirements. Purchasers will have to make their own decisions as to the properties regarded as most essential.

Following the draft specification, recommendations were made as to design, development, etc., which experienced users have found most advantageous. In some instances, these developments have been incorporated in the more recent models of some manufacturers.

5.1.1 *General, for compression sprayers*

5.1.1.1 Materials of construction: All metals, gaskets, and rubber tubing should be of chemical-resistant material.

5.1.1.2 Filters: Adequate filters, to protect moving parts and nozzles, should be provided.

5.1.1.3 Straps: 1 or 2 straps may be provided as desired for carrying the sprayer as a shoulder or as a knapsack type.

5.1.1.4 Capacity: The capacity of the tank should not exceed 4 US gallons (15.14 litres).

5.1.1.5 Weight: The weight of the sprayer when empty should not exceed 12 pounds (5.44 kg.) but should include the following attachments: belt, hose, control valve, extension tubing (spray lance), and nozzle.

5.1.2 *Cylinder*

The cylinder should have the following characteristics :

5.1.2.1 Pre-pressurized type tested to double the operating pressure.

5.1.2.2 Should be of seamless construction.

5.1.2.3 Should be fitted with a lipped concave base-plate welded to the walls, protected by an extension skirt about 1 to 1½ inches (2.5 cm. to 3.75 cm.) deep with rolled bottom edge.

5.1.3 *Tank top*

5.1.3.1 Should be of robust construction.

5.1.3.2 Should be welded to side walls and equipped with pump, filling hole, and safety valve.

5.1.4 *Pump*

5.1.4.1 Should be of seamless construction, easily detachable from the tank.

5.1.4.2 Should be fitted with a heavy duty plunger rod with “ D ”-type handle and durable, quick action, locking device.

5.1.4.3 The poppet valve should be air- and liquid-tight.

5.1.5 *Filling hole*

Should be not less than the equivalent of 2 inches (5 cm.) in diameter.

5.1.6 *Safety valve*

A quick-action safety valve positively set at operating pressure, should be fitted. This valve should be equipped with a manual release device.

5.1.7 *Straps*

Each pump should be provided with 2 substantial strap-hangers, the lower to be welded to the skirt and the upper to the top of the cylinder wall. Each strap should be about 1½ inches (3.75 cm.) wide, 1/8 inch (0.3 cm.) thick, and about 32 inches (80 cm.) long, with provision for ready adjustment.

5.1.8 *Discharge equipment*

5.1.8.1 Nozzle : Should be capable of producing a flat fan spray of uniform pattern, with a spray angle of not more than 65°. It should function at the lowest possible pressure.

5.1.8.2 Extension rod (lance): Should be of seamless construction. Each rod should be easily detachable and extendable. Joints must be leak-proof and positively sealed.

5.1.8.3 Spray-control valve: Should be robust, easily manipulated in one hand, and easily controlled with a positive non-drip shut-off.

5.1.8.4 Hose: Should be chemical- and oil-resistant. The length should be about 30 inches (75 cm.) and the inside diameter $\frac{3}{8}$ inch (1 cm.). It should be capable of withstanding maximum pump pressure.

5.1.8.5 Hose couplings: Hose to control valve should be of standard fitting and secured with a standard hose clamp. Hose to the tank barrel should be two-piece standard $\frac{3}{8}$ inch (1 cm.). The female coupling should be attached to the hose and equipped with wing nuts. The male coupling should be welded to the top, or to the side of the tank barrel just above the bottom plate.

5.1.9 *Technical improvements recommended*

5.1.9.1 Gooseneck attachment: A pipe curved 120° within an 8-inch (20 cm.) length of tubing should be standard equipment. This accessory may be placed at the extreme end of the extension rod and just before the nozzle. This curve enables the operator to manipulate the spray to advantage under many circumstances.

5.1.9.2 Filters: Two sets of filters are recommended, one to be incorporated at a convenient point after the control valve (it might conveniently be placed in the gooseneck attachment recommended in 5.1.9.1), and the other in such a way that the liquid is filtered as the tank is filled.

5.1.9.3 Filler caps: The threaded type of filler cap has been found to be unsatisfactory in that, after strenuous field use, the threads wear to such an extent that the cap leaks and finally may blow off under pressure. The established principle of the cleanout port of a steam boiler (with modifications) is suggested as a replacement for the threaded type of cap. The seal on this type is improved by pressure in the tank above atmosphere.

5.1.9.4 Discharge pipe: Discharge pipes fitted in the side of a tank just above the base-plate are to be preferred.

5.1.9.5 Quick detachable attachments: The extension tubes (lance), gooseneck attachments, and spray-nozzles holder should be fitted with standard interchangeable, leak-proof, quickly detachable attachments. Similar attachments could, with advantage, be provided for each end of the hose.

5.1.9.6 Automatic shut-off valve: Existing sprayers are inadequate in that the amount of insecticide deposited, as well as the spray pattern, are

affected by the continuously falling pressure. This results finally in ineffective performance below a certain pressure, characteristic of the nozzle in use. It is therefore recommended that (a) an automatic shut-off valve be incorporated in the liquor line which will function at the minimum effective pressure for the nozzle in use ; (b) a device be developed to deliver liquid to the nozzle at a constant pressure.

These refinements apply particularly to sprayers used for the residual spraying of buildings, as does the specification concerning the nozzle (see section 5.1.8). For larviciding, a nozzle giving a cone-shaped spray is equally suitable.

5.2 Specification for hand sprayers

Hand-sprayer equipment may be useful in the control of flies, mosquitos, and many other insects. This usefulness will often depend upon the vulnerability of the insect to certain procedures and to methods of dispersal of the insecticide in the attack upon the specific objective. For these reasons, it may be considered that the hand-spray dispersal-apparatus is a somewhat more flexible tool than the compression-type sprayers described above.

Since procedures against different developmental stages of the insect to be attacked may vary, it may become necessary to modify the equipment in use in order to increase efficiency in making the attack. These modifications should be made easily, quickly, and in a manner which will not interfere with normal functioning of the principal parts of the apparatus.

Modifications necessary to bring about the various desirable uses of hand-spray equipment are concerned almost entirely with actual spray nozzle parts, their construction and their assembly. General characteristics of the sprayer need undergo little or no alterations in order to meet them.

5.2.1 *General, for hand sprayers*

Hand-operated insecticide dispersal equipment, generally known as hand sprayers of the Flitgun type.

5.2.1.1 Materials of construction: All metals, gaskets, and rubber tubing (if any) should be of chemical-resistant material.

5.2.1.2 Filters: The use of filters in the construction of this type of pump is of doubtful value.

5.2.1.3 Straps: 1 shoulder strap *may* be provided which may act as a carrying device when the equipment is not in use or as a working unit when the equipment is in actual service.

The use of a strap on a household sprayer is not considered warranted unless it will be extensively used as a residual-spray unit.

5.2.1.4 Capacity: The capacity for continuous-spray units should not exceed 1 US quart (950 ml.). The capacity for intermittent-spray units *probably* should not exceed 1 US pint (475 ml.).

5.2.1.5 Weight: The weight of the sprayer should not exceed $1\frac{1}{4}$ pounds (567 g.) when empty. This weight includes all standard parts of the sprayer. It does not include such equipment as a shoulder strap or an extension tube (spray lance), neither of which are now furnished as standard equipment.

5.2.2 *Reservoir*

The 1-quart (950 ml.), or 1-pint (475 ml.), reservoir should have the following characteristics:

5.2.2.1 Tested to withstand double the operating pressure.

5.2.2.2 Seamless body construction.

5.2.2.3 Body-ends of adequate strength to withstand maximum (tested) internal pressure.

5.2.2.4 Body-ends attached to body by positive air- and liquid-tight seams.

5.2.2.5 Body-ends equipped with lipped extension of about $\frac{1}{8}$ inch (0.3 cm.) of body proper, rolled for added protection.

5.2.3 *Tank top*

Junction between reservoir, pressure pump, and nozzle assembly must be air-tight.

5.2.4 *Pump*

5.2.4.1 Barrel: Should be of seamless construction.

5.2.4.2 Plunger: Should be fitted with plunger rod of adequate strength for type of service.

5.2.4.3 Handle: Should be equipped with a "T" handle of adequate size so that the pumping operation does not tire the hand of the operator.

5.2.4.4 Bumper: Should be equipped with a "bumper" device (spring or rubber-resistant material) which is placed either as a hand-knuckle protective device between "T" handle and end of pump barrel; or over plunger rod, but inside the barrel where it acts as a bumper between end of pump barrel and pump leather assembly.

5.2.4.5 Barrel and assembly: Should be easily and quickly removable for emergency field cleaning and repairs.

5.2.4.6 Leather assembly: The pump leather assembly should be properly designed and adequate to hold the leather permanently in place for

maximum efficiency of operation. It should be constructed so that it may be quickly dismantled for cleaning or parts' replacement in field operation.

5.2.4.7 Pump air-check valve assembly : Should be positive in operation, of adequately rugged design to ensure long, hard service. Should be installed so that dismantling and cleaning may be easily accomplished in the field. This assembly may be omitted on intermittent-type sprayers.

5.2.5 *Filling hole*

Should be not less than 1½ inches (3.75 cm.) in diameter on quart-size (950 ml.) reservoirs and not less than 1 inch (2.5 cm.) on pint-size (475 ml.) reservoirs.

5.2.5.1 Filler caps : When in place, should be air-tight.

5.2.6 *Discharge equipment*

5.2.6.1 Capillary siphon tube :

5.2.6.1.1 Continuous-spray type : Should be firmly held in place so it will not fall out easily, but should be easily removable in case of emergency. It should be easily accessible for cleaning.

5.2.6.1.2 Intermittent-spray type : Should be air-tight at point of junction of tube and reservoir or other junction point. It should be easily accessible for cleaning.

5.2.6.2 Nozzles :

5.2.6.2.1 Continuous-spray type : Should function at the lowest possible working pressure. When pressure decreases below a certain point, characteristic of the nozzle, quick stoppage of liquid flow must take place in order to prevent deposition or leakage or wastage of large droplets.

5.2.6.2.1.1 For residual spray : Should be capable of producing a flat fan spray of a uniform pattern, with a spray angle of not more than 65°.

5.2.6.2.1.2 For larvicidal spray : May be capable of producing either a flat fan spray, a hollow cone type of spray or a solid cone type of spray. The type of pattern produced is relatively unimportant.

5.2.6.2.1.3 For aerosol spray : *Should be* capable of producing a relatively dry aerosol mist or space type of spray which shows no indication of gravity deposition within a distance of at least 36 inches (90 cm.) from the point of discharge.

5.2.6.2.2 Intermittent-spray type : Should function at the lowest possible working pressure. Immediate stoppage of liquid flow, when pressure drops below the nozzle characteristic pressure, is necessary.

5.2.6.2.2.1 For residual spray : Not considered entirely satisfactory as a residual-spray type.

5.2.6.2.2.2 For larvicidal spray : The type of pattern produced is relatively unimportant.

5.2.6.2.2.3 For aerosol spray : Should be capable of producing a relatively dry aerosol mist or space type of spray which shows no indication of gravity deposition within a distance of at least 36 inches (90 cm.) from the point of discharge.

5.2.6.2.3 The nozzle should be so placed or so constructed that it is readily accessible for cleaning under field conditions. It should remain firmly fixed in place with reference to the capillary siphon tube, so that alteration of pattern of spray will not take place.

5.2.7 *Technical improvements recommended*

5.2.7.1 Nozzles : The nozzle patterns recommended by the committee are all available at present. Improvement in design could bring about a type which would embody several patterns within the same nozzle.

In case of preference, 3 interchangeable nozzle pattern types may be made available for attachment to continuous sprayers. Patterns recommended include (1) residual-spray type ; (2) larvicidal-spray type ; (3) aerosol-spray type.

5.2.7.2 Nozzle extension : In order to meet the needs of a long, continuous, highly intensive service against mosquito larvae, an extension type of nozzle discharge is recommended for development. It consists of an accessory tube which, in essence, is an extension of the sprayer pump. It requires that the standard spray nozzle and spray-nozzle housing be detached from the standard body. An extension, about 26 inches (65 cm.) long, is attached to the pump cylinder in place of the standard (for the particular make) nozzle housing. This extension may house an extension capillary siphon tube which is attached to the standard siphon tube already in place.

The larviciding-type nozzle and its relative housing again may be attached to the discharge end of this extension tube. Larviciding then proceeds in the normal manner.

This type of equipment has been tried out very successfully under hard service field conditions. Its great advantages are two in number :

First, it is not necessary for the operator to work in a stooped position in order to do good larviciding. This stooped position is exceedingly tiring.

Secondly, a ruggedly made extension tube can penetrate through medium dense vegetative growth, thus permitting larviciding of certain "hard to get at" foci.

5.2.7.3 Hand grip : A hand grip is recommended for quart-size (950 ml.) sprayers. This grip should be firmly attached to the bottom of the reservoir and to the air cylinder. It should act as a base when the reservoir is being

filled. It should support the shoulder strap when the pump is in service, and it may act as a retainer for the strap when the pump is being carried but is not in service.

5.2.7.4 Strap: The pump strap should be about $1\frac{1}{2}$ inches (3.8 cm.) wide, $\frac{1}{8}$ inch (0.3 cm.), thick and about 60 inches (150 cm.) long. It should be provided with a means of ready adjustment.

In use, this strap passes through the grip of the pump, around the shoulder, and across the back of the operator. It provides significant relief from arm strain due to long periods of pumping. It assists in steadying the pump when applying residual sprays.

5.2.7.5 Hand-compression-type sprayers: This type of sprayer attempts to incorporate within one unit the characteristics of a compression sprayer and a hand sprayer. Pre-pressurizing the reservoir is borrowed from the compression sprayer. Light weight and flexibility of equipment and movement are borrowed from the hand sprayer. These are brought about in most cases by the addition of a positive control valve at some advantageous point in the discharge line.

This type of equipment is readily adaptable to modification of the hand sprayer by incorporation of the necessary control valve, which should be ruggedly constructed and positive in action. It should provide an immediate cut-off of insecticide in order to insure against dripping, waste, and staining.

General characteristics of continuous-spray-nozzle types of distribution for the hand sprayer remain unchanged in this type of sprayer.

6. Disinsection Methods for Quarantine Purposes

6.1 Disinsection of ships

6.1.1 The most comprehensive experience in this respect would appear to be that acquired in Sardinia in the application of measures intended to prevent the reinfestation of the island by anophelines after the latter's eradication.

The committee had before it the text of the quarantine regulations drawn up for the purpose by ERLAAS.

6.1.2 These regulations (see Annex 2), the substance of which the committee endorsed, provide for anti-anopheline treatment of all ships arriving in Sardinia which cannot produce a certificate of disinsection by residual action less than 2 months old, if they come from a port situated between 55° latitude North and 40° latitude South, or which, in spite of such disinsection, carried out within 2 months previously, reveal on inspection the presence of a mosquito of any species.

6.1.3 The method of disinsection employed comprises the use of the following procedures :

6.1.3.1 On the bridge and in the officers' quarters : Aerosol bomb containing pyrethrum.

6.1.3.2 In all other living, messing, galley, storage, and utility rooms, spaces and passageways : Either residual spraying (for vessels regularly plying between mosquito-infested ports and Sardinia) or pyrethrum aerosol bomb treatment (for vessels occasionally plying between mosquito-infested ports and Sardinia).

6.1.3.3 In the holds, engine-room, and other spaces : Residual treatment by means of shoulder pumps or with insecticide smoke canisters distributing into the air extremely fine particles of DDT powder (for ships under 200 tons) or with insecticide smoke canisters only (for ships exceeding 200 tons).⁵

The time required for disinsection of a cargo vessel of 2,000 tons is approximately 1½ hours.⁶

The committee was not in possession of sufficient data to enable it to recommend any particular method of disinsection for heavy tonnage passenger vessels, although it would appear that the use of aerosol bombs and insecticide smoke canisters would provide a satisfactory solution to the problem without undue delay to these vessels.

6.2 Disinsection of aircraft

The committee had before it the "Study on the disinsectization of aircraft in connexion with the revision of international conventions"⁷ and the "Report on the standardization of aircraft disinsectization methods",⁸ prepared for WHO by Dr J. Duguet.

6.2.1 *Points referred to the Expert Committee on International Epidemiology and Quarantine*

The committee left to the Expert Committee on International Epidemiology and Quarantine decision on the following points :

6.2.1.1 Definition of an aircraft suspected of being infested with insects which are possible vectors of disease. The committee suggested, however, that aircraft coming from areas free from malaria but possessing possible vectors of that disease should be considered as suspect.

⁵ The committee witnessed the operation on board a cargo ship of more than 1,500 tons and appreciated the fact that the method described above was both technically simple and rapid.

⁶ This estimate is based on 164 disinsections of ships, carried out in Cagliari between 5 April 1949 and 11 May 1949, comprising a total tonnage of 69,761 tons.

⁷ *Bull. World Hlth Org.* 1949, 2, 155

⁸ Unpublished working document WHO/Insecticides/2

6.2.1.2 Definition of the authority responsible for carrying out disinsection operations. The committee considered it necessary to cover by regulation the case of forced landing outside of aerodromes.

6.2.1.3 Sanctions which might be applicable to aircraft not carrying out their sanitary obligations as regards disinsection.

6.2.2 *Adaptation of disinsection technique to type of aircraft*

The committee recommended that disinsection measures should be adapted to the various types of aircraft: "classical" aircraft, pressurized aircraft, and certain military aircraft such as bombers.

6.2.3 *Disinsection on departure*

The committee approved the necessity of strict application of disinsection measures on departure⁹ (these are in fact laid down by the International Sanitary Convention for Aerial Navigation, 1933/44¹⁰), to be carried out as follows:

6.2.3.1 For all types of aircraft:

6.2.3.1.1 The baggage and freight compartments are to be disinfected after complete loading just before being closed for the last time.

6.2.3.1.2 The recesses provided for the landing gear, and all parts of the aircraft accessible only from the outside, and in which insects can find shelter, are to be disinfected 5 minutes before starting the engines.

6.2.3.2 In addition to measures outlined in sections 6.2.3.1.1 and 6.2.3.1.2:

6.2.3.2.1 For aircraft having non-pressurized cabins, the disinsection of cabins and annexes, cockpit and annexes, is to be carried out:

6.2.3.2.1.1 Immediately before the starting of the engines, after the embarkation of passengers and crew: Cabin ventilators will be stopped and the doors, portholes, windscreen, and other exterior apertures of the aircraft will be kept tightly closed during the spraying of the insecticide and for a period of not less than 5 minutes following the operation. When the aircraft remains on the ground after being disinfected, its doors shall remain closed; the cabin ventilators may, however, be started if their air-intake is provided with fine mesh screens; the portholes and windscreen may be opened only after the flight has begun; or

6.2.3.2.1.2 Ten minutes after the beginning of flight: Cabin ventilators will be stopped and the portholes, windscreen, or other exterior apertures

⁹ The committee desired to draw the attention of the Expert Committee on International Epidemiology and Quarantine to the fact that this measure appears in practice to be frequently neglected.

¹⁰ *Epidem. Inform. Bull.* 1945, **1**, 179

of the aircraft will be kept tightly closed during the spraying of the insecticide and for a period of not less than 5 minutes following the operation.

6.2.3.2.2 For aircraft having pressurized cabins, the disinsection of cabins and annexes, cockpit and annexes, is to be carried out after the embarkation of passengers and crew and the closing of the doors and windscreen, and during the period of time which elapses between leaving the parking area and the end of the period of warming the engines. Superchargers will be connected with the cabins and auxiliary ventilators put into operation only 5 minutes after the end of insecticidal spraying.

6.2.4 *Disinsection during flight*

6.2.4.1 The committee was of opinion that disinsection during flight is an effective method for aircraft of the classical type.

6.2.4.2 It does not appear to offer adequate guarantee in the case of aircraft with pressurized cabins, as conditioning and renewal of air interferes with the stability of the insecticide dispersed in the cabin.

6.2.5 *Disinsection after landing*

For the interior of the aircraft, where disinsection has not been carried out during flight, and for those parts of the aircraft accessible only from the outside, this operation is to be carried out after landing by the sanitary authority of the aerodrome.

This authority will take into account the means employed and the apparent efficacy of disinsection operations carried out on departure or during the flight, as well as any special risks, necessitating appropriate measures, to which the territory on which the aerodrome is situated is exposed.

6.2.6 *Composition, dosage, and forms of distribution of the insecticide in the aircraft*

6.2.6.1 For the interior of the aircraft, the committee recommended that use be made of: ¹¹

6.2.6.1.1 An aerosol of pyrethrins and DDT ¹² containing at least 1% in weight of pyrethrins I and II and at least 3% in weight of DDT.

¹¹ The committee recognized that new insecticides and formulations, including the use of synergists, are undergoing development and that the specifications given above are liable to modifications and/or additions where new formulations are approved by the committee.

¹² For the purpose of this report, an "insecticidal aerosol" is defined as a dispersion in the air of the insecticide solution or emulsion in which the large majority of particles on a weight basis are of diameter 5-25 microns.

The amount of insecticide dispersed should contain at least 50 mg. of pyrethrins per 1,000 cubic feet (28 m³) of enclosed space to be treated ; or

6.2.6.1.2 A pyrethrum extract in a standard solution, used as a freshly prepared aqueous emulsion or dissolved in completely volatile refined kerosene which does not soil and whose flash point is not less than 120° F. (49° C.). The amount of insecticide sprayed should be dispersed in the form of a fine and stable mist and contain at least 100 mg. of pyrethrins per 1,000 cubic feet of enclosed space to be treated.¹³

6.2.6.1.3 To ensure a uniform dispersion of the insecticide, the committee further recommended that in both instances the operator should spray all accessible parts of the aircraft, including cupboards, chests, clothes compartments, etc., and that particular attention be given to spaces under seats where diffusion of the insecticide would otherwise be very slow.

Ventilation will be stopped and all exterior apertures of the aircraft kept tightly closed during the spraying and for a period of not less than 5 minutes following the operation.

Foodstuffs which may be inside the aircraft must be kept from any contact with the insecticide.

6.2.6.2 For the exterior parts of the aircraft, which might constitute shelter for insects, or for parts accessible only from the outside, the committee was of opinion that, for the sake of economy, disinsection could be carried out with a weaker solution, containing at least 0.1% in weight of pyrethrins I and II and 0.3% in weight of DDT in completely volatile refined kerosene¹⁴ as specified under section 6.2.6.1.2. The amount of insecticide should be dispersed in the form of a fine and stable mist and contain at least 50 mg. of pyrethrins per 1,000 cubic feet of enclosed space to be treated. The quantity of insecticide to be sprayed in any cavity or exterior part of the aircraft which cannot be completely closed must equal thrice the amount of insecticide prescribed for an enclosed space of corresponding volume.

¹³ Any solvent or emulsifying agent employed in spraying the aircraft cabin or the cockpit should be such as not to damage the insulation of electric wiring or Plexiglas Perspex dials or windowpanes.

¹⁴ Because of the inflammable nature of vaporized kerosene, such insecticidal solutions will only be used when the motors of the aircraft are resting. When electric-motor or petrol-motor compressors are used to produce compressed air, they will be kept at the distance required for safety.

7. Measures to Prevent Introduction or Re-introduction of Anophelines

The committee was of opinion that :

7.1 Disinsection of incoming sea- and aircraft constituted a substantial obstacle to such introduction, provided it was carried out under an appropriate technical authority, with proper insecticides and methods, at both sea- and airports. *Mutatis mutandis*, such disinsection was applicable to land traffic wherever indicated.

7.2 Disinsection by quarantine services at ports and borders did not provide complete security, and that a systematic search for anophelines in the areas free or freed from them had to be set up or maintained, to enable immediate intervention against focal infestation following accidental importation.

7.3 For proper co-ordination of the work, it was desirable to place under a single authority the service of disinsection at sea- and airports and the anti-mosquito service as described in section 7.2.

7.4 In areas where malaria-carrying anophelines have been eradicated, the maintenance of residual-spraying activities for general domestic insect-control constituted, in general, an effective means of destroying accidentally imported anophelines.

7.5 Naturally, should a general insect-control service be established, the search for accidentally imported anophelines and their destruction would be entrusted to the general insect-control service which, in the view of the committee, should be placed under the same authority and staff responsible for disinsection at sea- and airports.

7.6 In areas from which anopheline species have been eradicated, it was necessary strictly to enforce compulsory notification and laboratory confirmation of any case of malaria occurring therein, so that epidemiological inquiries might lead to the discovery and eventual destruction of accidentally imported anophelines.

7.7 The committee noted that disinsection of aircraft, as recommended in section 7.1, was already provided for under Article 54 of the International Sanitary Convention for Aerial Navigation, 1933/44. The committee recommended that the possibility of extending such disinsection to sea and land traffic, when indicated, should be provided by special international agreements or regulations.

7.8 The committee considered it desirable that, under such agreements or regulations, seaports and airports open to international traffic be made as free as possible from mosquitos and from other disease-bearing insects.

8. Role and Limitations of Insecticides in Domestic-Fly Control

8.1 The committee recognized that there was an increased realization of the sanitary importance of domestic flies and that the new insecticides gave a hope of control quite impossible in the past.

8.2 The committee recognized that a high degree of control of domestic flies had already been achieved in certain areas of the world by residual spraying alone (e.g., in Sardinia by ERLAAS) and also noted that domestic-fly populations which had developed resistance to DDT could be controlled by changing the insecticides used (in Sardinia, from DDT to chlordan).

8.3 While the control of domestic flies had been achieved in some instances by residual spraying alone under insanitary conditions, the committee recognized that the improvement of such conditions would make a useful contribution to the control measures.

8.4 The committee was of the opinion that more data concerning the habits and habitat of domestic flies in various regions of the world were urgently required if the optimum use of the new insecticides was to be made; also that field investigations were necessary on the results of a direct attack upon the domestic fly instead of the indirect attack usually carried out as a subsidiary part of a mosquito-control scheme. In this work, attention should be directed towards the breeding places of the flies and to the development of effective fly-larvicides.

8.5 As far as DDT-resistant flies are concerned, chlordan and BHC have been found to be satisfactory alternatives as regards killing; but they lack the long residual activity associated with DDT, and their use may necessitate additional spraying operations (involving extra labour cost) if satisfactory control is to be achieved.

8.5.1 Investigations aimed at increasing the residual effects of these insecticides or developing equally efficient but more persistent compounds should be undertaken to provide more satisfactory substitutes for DDT.

9. Interchange of Information and Literature

In view of the rapid progress being made in insecticides and their application, including relevant equipment, the committee recommended that information on these subjects be made rapidly available by WHO to health administrations, specialized services, and individual experts.

Such information should include progress reports on research and field work, presented as informative abstracts, reprints or, upon request, microfilm copies of original articles. In order to avoid duplication and over-

lapping, the committee suggested the possibility of taking advantage of existing national information services and publications, such as the *Insecticides Abstracts and News Summary* issued in the United Kingdom by the Inter-departmental Insecticide Committees of the Agricultural Research Council.

10. Waiving of Customs Duties on Material for Insect Control ¹⁵

The committee noted with satisfaction the resolution passed by the Economic and Social Council of the United Nations at its eighth session, on the recommendation of the Economic Committee, by which the Secretary-General of the United Nations was requested to prepare a "report on the production, distribution and availability of those insecticides (e.g., DDT, BHC, etc.) which are valuable in the control of malaria".¹⁶

The committee wished to point out that in many non-manufacturing countries, and particularly in undeveloped territories, customs duties on insecticides, solvents, and equipment necessary for insect-control campaigns constituted an obstacle to the extension of their use; and it recommended that the waiving of customs duties on such material be given serious consideration by the Economic and Social Council at its next session.¹⁷

11. Panel of Experts on Insecticides

The committee, considering the diversity of the fields it was to cover, such as : the chemistry of insecticides ; the bio-assay of insecticides ; insect physiology ; the modes of action of insecticides ; the physical chemistry of insecticidal formulations ; the development of insecticides adapted to local circumstances, and of the equipment for their application from the ground

¹⁵ The Second World Health Assembly adopted the following resolution (WHA2.18) :
The Second World Health Assembly . . .

(3) REQUESTS the Director-General to refer to the attention of the Economic and Social Council at its next session the serious consideration of the proposal that countries waive customs duties on material for insect control in view of the very important sanitary and economic benefits to be expected from their use on a large scale ;

(*Off. Rec. World Hlth Org.* **21**, 23)

¹⁶ See resolution 184 (VIII), 10 March 1949, of the Economic and Social Council of the United Nations. *Official Records of the eighth session of the Economic and Social Council. Supplement No. 1. Resolutions*, page 4.

¹⁷ See resolution 225 (IX), 14 July 1949, of the Economic and Social Council of the United Nations. *Economic and Social Council. Official Records : Fourth Year, Ninth Session. Supplement No. 1. Resolutions*, page 19.

and the air ; the toxicity of insecticides to mammals, etc., expressed its satisfaction with the form recommended by the First World Health Assembly for the Expert Committee on Insecticides, i.e., a small nucleus and a panel of specialized members to be co-opted according to the subjects selected for the agenda of each session.¹⁸

12. Harmlessness of DDT to Man

The committee wished to state that overwhelming evidence showed the harmlessness to man and mammals of DDT as commonly applied for residual spraying and accordingly deplored rumours to the contrary. The committee, aware that the further experimental work now in progress supported the available evidence, decided to place on the agenda of its next session the consideration of reports on this work.

13. Rodenticides

The committee learned that the Expert Committee on International Epidemiology and Quarantine had expressed the desire to obtain technical information on recently developed rodenticides and methods for their use ; and, considering that in the control of some insect-borne diseases, such as plague and murine typhus, rodent control was the complement of flea control, agreed to place this subject on the agenda of its next session and suggested that specialized experts be co-opted for the purpose.

¹⁸ *Off. Rec. World Hlth Org.* **13**, 304

Annex 1

METHODS FOR DETERMINATION OF CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF TECHNICAL DDT

1. Determination of the Setting-Point

Carefully melt a sufficient amount of the sample in an 8-inch $\times$ 1-inch (20 cm. $\times$ 2.5 cm.) boiling-tube to give a depth of liquid of approximately 3 inches (7.5 cm.) in an oil-bath at 110°-115° C., immersing the bottom of the tube 4 inches (10 cm.) below the surface of the oil. If hydrogen chloride is evolved during the melting, another portion of the sample must be taken and melted in a bath at a lower temperature.

Insert this boiling-tube, by means of a cork collar, to within $\frac{1}{2}$ inch (1.25 cm.) of the bottom of a second boiling-tube, size 6 inches $\times$ 1 $\frac{1}{2}$ inches (15 cm. $\times$ 3.75 cm.), immersed to a depth of 4 inches (10 cm.) in a water-bath maintained at 70° C. Place in the inner boiling-tube a stirrer bent to fit round a thermometer clamped in a central position with its bulb 1 inch (2.5 cm.) from the bottom of the tube (the temperature of the melt should be approximately 10° C. higher than the anticipated setting-point at this stage).

Stir at the rate of about 2 strokes per second until the material begins to thicken, at which point stir vigorously, working into the melt portions of the material purposely solidified on the walls of the tube. Stop stirring when the temperature begins to rise and record the highest steady temperature as the setting-point.

Apply corrections as necessary for the thermometer calibration and emergent stem.

The setting-point apparatus should be shielded from draughts.

2. Total Organic Chlorine Content

The modified Winter method specified in section 2.1 is recommended. The use of the Parr peroxide-bomb method described in section 2.2 will be permitted. However, in the event of dispute, the results obtained with

the modified Winter method shall govern. The correction factor applicable to the method used shall be determined using the following equation :

$$f = \frac{T}{A}$$

where

f = correction factor

T = theoretical calculated value for chlorine in pure, recrystallized DDT

A = apparent value for chlorine in pure, recrystallized DDT as determined by the method used

The results obtained for each sample by a given method shall be multiplied by the applicable correction factor.

2.1 *Winter method*

The chlorine content of the DDT shall be determined using the apparatus illustrated in fig. 1.

U-tube. The U-tube for weighing and volatilizing the sample of DDT shall be made of 9-mm. glass tubing on the longer side and 1-mm. glass capillary-tubing on the shorter side as illustrated in fig. 1.

Heater device. The device for heating and volatilizing the sample of DDT in the U-tube shall consist of approximately 10 feet (3 m.) of No. 28 American wire gauge (0.01264-inch diameter) nichrome wire, wound 10 turns per inch (2.5 cm.) over a strip of narrow asbestos tape which shall be placed over the section of the tube indicated in fig. 1. The heater shall be controlled by a suitable variable auto-transformer.

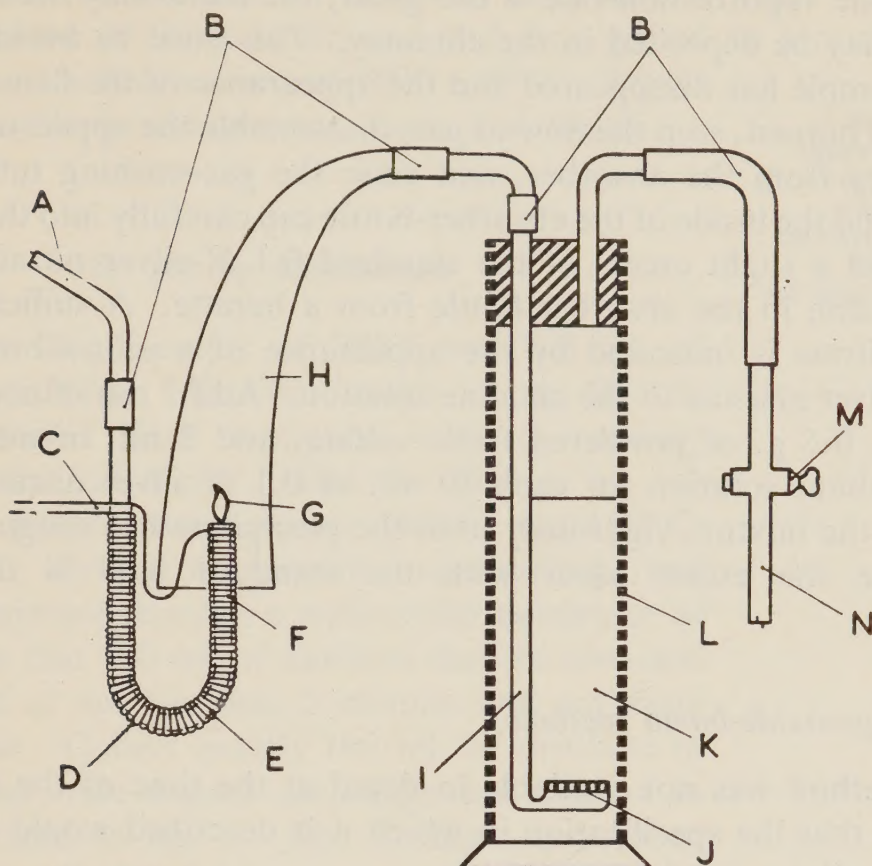
Chimney. The chimney shall be a glass adapter having an 18-mm. internal diameter at its larger opening.

Absorber. The absorber shall be a 250-ml. gas-washing bottle containing a gas-washing tube having a fritted-glass dispersion disc of medium porosity.

Gas-absorber solution. The solution used to absorb the chlorine shall be approximately 0.1 N with respect to sodium carbonate or hydroxide, and 0.1 N with respect to sodium arsenite. The sodium arsenite may be readily obtained by dissolving the requisite amount of arsenic trioxide in a small quantity of sodium hydroxide. This arsenite solution shall be tested to ascertain the absence of halide.

Reagents. A standardized 0.1 N solution of silver nitrate and 0.05 N solution of potassium thiocyanate shall be employed to determine the inorganic chloride ion in the absorber solution. The ferric sulfate, nitrobenzene, and concentrated nitric acid used in the determination shall be halogen-free.

FIG. 1. APPARATUS FOR DETERMINATION OF CHLORINE IN DDT



WHO 5223

A = connect to fuel gas or hydrogen
 B = rubber tubing
 C = to transformer
 D = heating device, nichrome wire wound over asbestos
 E = 9-mm. glass U-tube
 F = 1-mm. glass capillary tubing
 G = flame (1 cm. high)
 H = chimney (glass adapter)

I = gas-washing tube
 J = fritted-glass dispersion disc (medium porosity)
 K = absorber solution
 L = absorber (250 ml. capacity gas-washing bottle)
 M = stopcock
 N = connect to vacuum line

Procedure. Place approximately 50 ml. of the gas-absorber solution in the absorber. Adjust the stopcock leading to the vacuum line to allow the minimum amount of air through the system necessary to support a flame 1 cm. high at the 1-mm. opening of the U-tube when fuel gas or hydrogen passing through the system is ignited at that point. Remove the U-tube from the apparatus, weigh, and introduce a 0.1- to 0.2-g. sample of the DDT into the 9-mm. opening of the tube. Weighings may be carried out by suspending the U-tube from the stirrup hook of an analytical balance by means of a wire loop. Place the heating device, as shown in fig. 1, over the U-tube, which shall then be inserted into the apparatus. Adjust the flow of gas to produce a flame 1 cm. high at the 1-mm. capillary opening of the U-tube when the gas is ignited. Immediately place the chimney over the flame. Turn on the heating device and adjust so that the temperature rises slowly toward the sublimation-point of the sample. A trial

run should be made to determine the volatilization characteristics of the DDT. If the vaporization-rate is too great, the flame may become smoky and soot may be deposited in the chimney. This must be avoided. Soon after the sample has disappeared and the appearance of the flame indicates that it is all burned, stop the flow of gas, disassemble the apparatus, remove the chimney from the absorber, and rinse the gas-washing tube, dispersion disc, and the inside of the absorber-bottle cap carefully into the absorber bottle. Add a slight excess of the standard 0.1 N silver nitrate solution to the solution in the absorber bottle from a burette. A sufficient excess of silver nitrate is indicated by the appearance of a yellow-brown precipitate of silver arsenite in the alkaline solution. Add 2 ml. of concentrated nitric acid, 0.5 g. of powdered ferric sulfate, and 3 ml. of nitrobenzene to the resultant solution for each 10 ml. of 0.1 N silver nitrate solution used. Stir the mixture vigorously until the precipitate has coagulated, and then titrate the excess silver with the standard 0.05 N thiocyanate solution.

2.2 *Parr peroxide-bomb method*

This method was not available in detail at the time of the report. It was hoped that the specification in which it is described would have been available earlier.

3. Determination of Hydrolysable Chlorine Content

Accurately weigh approximately 0.5 g. ("w" grams) of the sample into a 250-ml. flask. Add 40 ml. of N/2 alcoholic potassium hydroxide, and gently reflux for half-an-hour. Wash down the condenser with distilled water and allow to cool. Add 20 ml. of 2 N nitric acid, exactly 25 ml. of N/10 silver nitrate, 5 ml. of nitrobenzene, and 5 ml. of ferric-alum solution. Back titrate with N/20 potassium thiocyanate (factor "f", titre "a" ml.). The end-point is the appearance of the red ferric-thiocyanate colour.

Carry out a blank determination on the reagents used in exactly the same way (titre "b" ml. of N/20 potassium thiocyanate).

$$\text{Then \% hydrolysable chlorine} = \frac{(b-a)f:0.1775}{w}$$

4. Ash

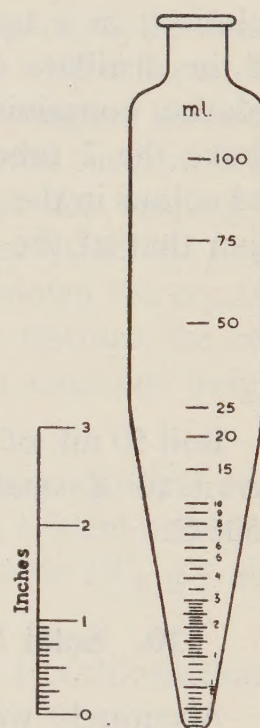
Place a 2-g. sample in a weighed crucible. Burn off or vaporize the DDT under a hood with a good ventilation, over a low flame or from

a sand-bath. When the organic material has been substantially volatilized, cool the crucible and add an excess of 10% sulfuric acid. The crucible shall be heated as above to dryness and then ignited in a muffle furnace for 1 hour at a temperature of $800^{\circ} \pm 50^{\circ} \text{C}$. Transfer the crucible to a desiccator, cool, and weigh.

5. pH by Distillation

Place a 20-g. sample of DDT and 200 ml. of carbon-dioxide-free distilled water in a 500-ml. round-bottomed flask equipped with a mercury sealed mechanical stirrer. Heat the flask in an oil-bath at a temperature between 140°C . and 160°C . with rapid stirring to prevent superheating, and distil the mixture through a well-cooled condenser at such a rate that 100 ml. of distillate shall be obtained in a period of not less than 3 minutes and not more than 1 hour. Collect exactly 100 ml. of distillate in a calibrated cone-shaped centrifuge-tube similar to that illustrated in fig. 2. The distillate is used to determine water-insoluble, steam-volatile material and chloral hydrate as well as pH. Cool the residue in the flask to room temperature and filter. Determine the pH of the filtrate. Both distillate and filtrate must fall within the specified range.

FIG. 2.
CONE-SHAPED
CENTRIFUGE-TUBE
USED IN
DETERMINATION
OF pH
BY DISTILLATION



WHO 5224

6. pH by Extraction

Transfer a 20-g. ($\pm 0.1 \text{ g.}$) sample of DDT to a 500-ml. separating funnel and dissolve in 100 ml. of benzene. Add 50 ml. of freshly-distilled, cooled, carbon-dioxide-free water, stopper, and shake the funnel and contents for 3 minutes. Allow the 2 phases to separate and draw off the aqueous layer into a flask. Stopper this flask immediately. Repeat the aqueous extraction twice, using 2 successive 25-ml. portions of freshly-distilled, cooled, carbon-dioxide-free water. Determine the pH of this extract, using any suitable method. However, in the event of dispute, the results obtained with a calibrated pH electrometer shall govern. Reserve the remainder of this extract for the determination of chloral hydrate and water-soluble material.

7. Water-Insoluble, Steam-Volatile Material

Centrifuge the distillate (section 5) until the volume of water-insoluble layer can be clearly read.

8. Chloral Hydrate

The distillate (section 5) or the aqueous extract (section 6) may be used. Place 2 ml. of a sodium hydroxide solution (40 g. in 100 ml. of solution) in a test-tube, and add 1 ml. of colourless pyridine and 4 ml. of the distillate or extract. Similarly treat 4 ml. of a standard aqueous solution containing 0.05 mg. of chloral hydrate per ml. in another tube. Shake the 2 tubes and heat in a boiling-water bath for 1 minute. The red colour in the pyridine layer of the sample under test shall not be darker than that of the standard.

9. Water-Soluble Material

Boil 50 ml. of the filtrate (section 5) or of the aqueous extract (section 6) down to a small volume, and dry the residue to constant weight at 150° C.

10. Solid Matter Insoluble in White Spirit or Cyclohexanone

Accurately weigh approximately 10 g. of the sample into a 250-ml. beaker. Add 100 ml. of white spirit or cyclohexanone and stir well to dissolve. Filter through a sintered-glass crucible of porosity No. 3 and wash insoluble residue with four 10-ml. portions of white spirit or cyclohexanone. Dry the crucible and residue for 1 hour at 105° C.; cool in a desiccator and weigh. After weighing, treat the residue with 25 ml. of distilled water and titrate the solution so obtained with N/10 hydrochloric acid, using a solution of methyl orange as indicator.

11. Determination of the *p, p'*-Dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane Content

Weigh 10 g. of the material into a 150-ml., tall-form, unlipped beaker. Add 50 ml. of a saturated solution of recrystallized *p, p'*-dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane in absolute alcohol.¹ This solution must

¹ Industrial methylated spirit 74 O.P. may be used instead of absolute alcohol.

be prepared and filtered at $18^{\circ} \pm 0.5^{\circ} \text{C.}$, as described below, and used at a temperature not lower than 18.5°C. so that no crystals are present. Close the beaker with a small round-bottomed flask containing cold water to act as a condenser, and very carefully heat the contents to boiling, effecting solution without loss of alcohol. With the flask still in position, allow the contents of the beaker to cool slowly on the bench and, when crystallization commences, gently swirl the contents to cause crystallization throughout the whole body of the solution. After 1 hour place the beaker, adequately covered to prevent evaporation of alcohol or ingress of water vapour, in a thermostat at $18^{\circ} \pm 0.5^{\circ} \text{C.}$ until crystallization is complete (usually 1 hour will suffice but considerably longer may be necessary). Break down the network of crystals in the beaker with a flat-ended stirring rod, transfer to a weighed Gooch crucible or a weighed sintered-glass crucible of porosity No. 2 ($W_1 \text{ g.}$) and, applying gentle suction, draw off most of the solution. Complete the transference and the washing of the crystals with 20 ml. of the alcohol saturated with recrystallized *p, p'*-dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane, crushing down the crystals tightly with a flat-ended glass rod, and, finally, draw air through the crucible for 5 minutes. Dry the crucible and contents to constant weight ($W_2 \text{ g.}$) at 80°C.

Simultaneously, carry out a blank determination under identical conditions using 7.0 g. of *p, p'*-dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane of melting-point not less than 109°C. Weigh the crucible ($W_3 \text{ g.}$) and crucible plus crystals ($W_4 \text{ g.}$) as above.

The percentage of *p, p'*-dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane in the material is given by the expression :

$$10 (W_2 - W_1) - 10 (W_4 - W_3 - 7)$$

Confirm the purity of the crystalline product by determining the melting-point by the capillary-tube method.

11.1 *Preparation of the saturated alcoholic solution*

Dissolve about 200 g. of the recrystallized *p, p'*-dichloro-2 : 2-diphenyl-1 : 1 : 1-trichloroethane of melting-point not less than 106°C. in approximately 1 litre of hot absolute alcohol.² Pour the solution into a Winchester containing 1.5 litres of alcohol and allow to stand undisturbed in a thermostat at $18^{\circ} \pm 0.5^{\circ} \text{C.}$ for at least 24 hours before filtering for use.

For the determination of the total organic chlorine content (section 2), another method involving reduction with metallic sodium and *iso*-propyl

² Industrial methylated spirit 74 O.P. may be used instead of absolute alcohol.

alcohol is at present under investigation. Should it be found to be satisfactory, it will be considered by the committee as an alternative to the methods described in sections 2.1 and 2.2. It involves a somewhat simpler technique than the other methods.

Annex 2**EXTRACTS FROM DRAFT QUARANTINE REGULATIONS
(AND PROCEDURES)
FOR SARDINIA, PROPOSED BY ERLAAS****1. Surface Craft : Regulations Applying to Inbound Vessels****1.1 General regulations to be followed by quarantine officers at all Class I and Class II ports**

Seven Sardinian ports are classified in Class I and 17 in Class II by ERLAAS. Port classification depends upon two factors : (1) port activity, (2) tonnage. More emphasis is placed upon port activity than upon tonnage. All Class I ports, however, receive vessels of 1,500 tons or more.

.....

Article 2. Upon receipt of notification of an inbound vessel or other water-borne craft, the quarantine officer will prepare to inspect and/or disinsect said vessel or craft according to regulations prescribed for the local port.

Inspection and/or disinsection must be carried out expeditiously and with minimum delay.

Article 3. Vessels which must be disinsected will be disinsected according to the treatment sections into which the vessel is divided (see sections 1.3 and 1.4).

.....

1.2 General procedure at Class I ports

Article 1. Vessels calling at Class I ports will proceed according to the measures proposed by the Italian Government.¹

¹ It may be noted that the First World Health Assembly recognized "the right of the Italian Government to apply, at its own expense, measures of disinsectization, apart from those required by existing international sanitary conventions, of the character specified in the appendix to this resolution (p. 304)". (*Off. Rec. World Hlth Org.* 13, 301)

Among such measures, it was mentioned that, while awaiting inspection, ships arriving at Sardinian ports shall be kept at a reasonable distance from land (about 400 metres if possible), and this clause has been applied by ERLAAS in Class I ports. — ED.

Article 2. The port quarantine officer will examine any document presented by the master of the vessel which shows whether said vessel has been treated with a prescribed residual insecticide during the preceding 2 months.

Article 2.1. In case a valid document exists, the port quarantine officer will inspect the vessel (officer quarters, crew quarters, hold) using a flashlight and catching tube. If no mosquitos are found, the inspection will be considered satisfactory.

Article 2.2. In case a mosquito *of any type* is found, the vessel will be re-treated immediately even though a valid certificate of treatment exists.

Article 2.3. In case no valid certificate of treatment exists for the vessel, it will be treated immediately with the prescribed amount of residual insecticide.

Article 2.3.1. A recognizable, stencilled, residual-insecticide sign will be placed on the vessel in some easily located place. This sign will show date, port where treated, and material used.

Article 2.3.2. Form III will be executed in triplicate.

One copy will remain with the master of the vessel to be used by him as his certificate of authority to enter any other quarantined (Sardinian) port without re-treatment during a following 2-month period—excepting as noted in Article 2.2 above.

.....

Article 4. After above procedure is satisfactorily completed, the vessel may be allowed to proceed to pratique.

1.3 Treatment procedure at Class I ports

Article 1. All vessels will be divided roughly into 3 treatment sections. These sections may overlap or may not exist. While treatment for each section may be specified, these specifications may be modified to meet conditions, i.e., an aerosol may be used in crew quarters instead of residual disinsection of these quarters if fogging with an aerosol is more practicable.

The 3 treatment sections are as follows :

Article 1.1, Section 1. The bridge and officers' quarters :

Treatment recommended : Aerosol bomb spray with pyrethrum.

This treatment will be applied to all vessels, even if the vessel carries a bona fide quarantine document showing treatment with residual insecticide during the previous 2 months. It may be omitted if the vessel has cleared

from any port north of 55° N or south of 40° S and has not subsequently touched at any port between these latitudes.

Article 1.2, Section 2. All other living, messing, galley, storage, and utility rooms, spaces and passageways, excepting those designated as holds :

Article 1.2.1. In vessels regularly plying between mosquito-infested ports and Sardinia, these quarters will be residually sprayed by means of shoulder pumps using the prescribed amount of residual insecticide.²

Article 1.2.2. In vessels *occasionally* plying between mosquito-infested ports and Sardinia, these quarters will be treated with pyrethrum aerosol bombs.

Article 1.3, Section 3. Holds, engine rooms, and other spaces :

Article 1.3.1. In ships under 200 tons, these spaces will be residually sprayed by means of shoulder pumps, using a prescribed residual insecticide, or with insecticide canisters.² It is realized that access is impossible to a hold full of goods. A decision on method of treatment under such conditions must be considered and executed by the quarantine officer. Insecticide smoke canisters probably should be used.

Article 1.3.2. In ships exceeding 200 tons, holds will be treated with insecticide smoke canisters.

Article 1.3.3. Engine rooms and other spaces of all vessels exceeding 200 tons will be treated with insecticide smoke canisters, unless, in the opinion of the quarantine officer, such treatment is deemed unnecessary. Procedure the same as for holds (see section 3.2.2.3).

1.4 Treatment procedure at Class II ports

Article 1. All vessels calling at Class II ports will be permitted to dock.

Article 2. The vessel master will immediately notify the port quarantine officer of his arrival.

Article 3. The port quarantine officer will be supplied with a shoulder pump sprayer and a prescribed residual insecticide.

Article 4. The port quarantine officer will examine any document presented by the master of the vessel which shows that said vessel has been treated with a prescribed residual insecticide during the preceding 2 months.

² A recognizable, stencilled, residual-insecticide sign will be placed on the vessel in some easily located place. This sign will show date, port where treated, and material used.

Article 4.1. In case a valid document exists, the quarantine officer will inspect the vessel (officer quarters, crew quarters, hold) using a flashlight and catching tube. If no mosquitos are found, the inspection will be considered satisfactory.

Article 4.2. In case a mosquito *of any type* is found, the vessel will be re-treated immediately even though a valid certificate exists.

Article 4.3. In case no valid certificate of treatment exists for the vessel, it will be treated immediately with the prescribed amount of residual insecticide ³ (see section 3.2).

Article 4.4. Form III will be executed in triplicate.

One copy will remain with the master of the vessel to be used by him as his certificate of authority to enter any other quarantined (Sardinian) port without re-treatment during a following 2-month period—excepting as noted in Article 4.2 above.

.....

1.5 Status of inbound vessels relative to quarantine service and with respect to mosquitos

All inbound vessels will be subjected to quarantine inspection. These vessels will be permitted to proceed to pratique when they have fulfilled international quarantine regulations and the following local (Sardinian or Italian) obligations applying to them :

Article 1. Any vessel will be exempt from further quarantine inspection, provided said vessel has cleared from any port north of the 55th parallel of north latitude or south of 40° of south latitude and has not subsequently touched at any port between these latitudes.

Article 2. Any vessel not listed under Article 1 of this section will be exempted from further quarantine provided it carries a valid certificate of residual insecticidal treatment (this does not include treatment with pyrethrum or aerosol bombs) and it has been locally treated on this voyage with aerosol bombs as authorized under section 1.3.

Article 3. Any vessel excluded from the foregoing categories will be treated.

Article 4. All Sardinian coastal craft will be regularly treated by residual disinsection at a time when the hold of said vessel is empty.

³ A recognizable, stencilled, residual-insecticide sign will be placed on the vessel in some easily located place. This sign will show date, port where treated, and material used.

Article 4.1. It becomes the duty of the master of said craft to submit his vessel for treatment according to this regulation in sufficient time before the expiration date of his quarantine certificate to permit re-treatment to be carried out.

Article 4.2. In case the master fails to comply with the above regulations and subsequently re-enters a Sardinian port, his vessel will be treated as a "foreign" vessel at the time of entry, inspected and treated before clearance is granted, or be impounded until such time as the master places it at the disposal of the quarantine disinsection authority.

1.6 Search for insects : surface craft

Article 1. Search for insects will be made *after* disinsection or after complete compliance with quarantine regulations.

Article 2. All surface craft will be inspected for insects whenever re-entering a Sardinian port after calling at any foreign or Italian port other than Sardinia.

Article 3. Vessels considered under Articles 1 and 2 of section 1.5 will be systematically searched for live insects.

Article 4. In case insects are found (dead or alive), the number captured will be noted on the sample bottle provided and entered on the relevant form. The sample bottle will be dispatched immediately to the designated entomological station for inspection.

2. Aircraft : Regulations Applying to Inbound Aircraft

2.1 Regulations to be followed by pilot of aircraft

Article 1. All air transport services entering any airport on the Island of Sardinia will be subject to quarantine inspection. This inspection will be carried out as expeditiously as possible.

Article 2. It will be the responsibility of the pilot of any aircraft to announce his approximate time of arrival via radio at a specific airport at least 15 minutes in advance.

In case the specified airport is not equipped with radio, or in case no other means of prior announcement of arrival is available, the pilot will post his plane in accordance with international regulations.

The pilot will then authorize a crew member to contact the proper quarantine authority.

The pilot may permit passengers and crew to disembark provided this is accomplished expeditiously.

After passengers and crew have disembarked, all doors and port-holes of the aeroplane must remain closed until full quarantine regulations and inspections have been completed.

2.2 Regulations to be followed by ground control-tower

Article 1. Advance announcement of arrival of any aeroplane to the personnel in charge of quarantine will be the responsibility of control-tower personnel.

When the control-tower officer receives advance notification of arrival of a specific aircraft, he will immediately dispatch notification of estimated arrival hour to the quarantine officer. He will use Form VII for this purpose. Form VII will be executed in duplicate. Two copies will be dispatched to the quarantine officer.

One copy will be signed by the quarantine officer and returned to the control-tower for filing purposes. The hour the document is signed by the quarantine officer will be inscribed. The second copy will remain in the files of the quarantine officer.

2.3 Regulations to be followed by airport quarantine officer

Article 1. The quarantine officer will complete Form VII immediately upon presentation by inserting the hour he has received the same and by affixing his signature to it.

Article 2. In case notification of aircraft arrival has been received by telephone rather than by messenger, the quarantine officer will proceed to the control-tower as soon as convenient, but within 12 hours, and will sign the control-tower copy of the notification form. At the same time he will secure a copy of the same document for his files.

Article 3. Upon receipt of notification from the control-tower (or from any other source) of the arrival of an aircraft, the quarantine officer will prepare to inspect and/or disinfest said craft according to prescribed regulations.

Inspection and/or disinsection must be carried out expeditiously and with minimum delay.

Article 4. It will be the duty of the quarantine officer to maintain his equipment in good working order, immediately accessible, and available for use.

Article 5. Aerosol bombs will be the basic implement used in the disinsection service.

Article 6. In case aerosol bombs are not available, then hand-spray apparatus must be accessible. A quantity of properly mixed pyrethrum

must be always ready. Proper method for mixing this insecticide is described in section 3.1.3.

Article 7. The local quarantine officer will execute Form V in triplicate for each inbound aircraft.

One copy will be handed to the plane pilot for his record.

2.4 Categories of aircraft from the standpoint of disinsection procedures

Article 1. All aircraft, whether passenger, cargo, military, or private, will be divided into 3 categories :

Category A — Italian domestic airlines plying between Italian ports only

I. Regular Sardinian service

II. Intermittent Sardinian service

Category B — Italian international airlines plying between Italian and foreign ports

Category C — Foreign airlines flying any foreign service flag.

2.5 Italian domestic lines

2.5.1 *Regular service lines to Sardinian airports*

Regular service airlines to Sardinian ports will have the aircraft divided into 2 types of compartments from the point of view of disinsection.

2.5.1.1 *Compartments (a) : readily accessible while plane in flight :* i.e., passenger and crew compartments.

2.5.1.1.1 Compartments (a) will be treated while the plane is in flight. This will be a duty of a regularly assigned crew member. Treatment will take place as soon as possible after the last take-off before landing at a Sardinian port but at least half-an-hour prior to landing. Cabin ventilators will be stopped during treatment and for 5 minutes thereafter. In case 2 or more Sardinian ports are visited consecutively on the same flight routine, re-treatment will not be necessary after the first port of call.

2.5.1.1.2 Record of treatment time (hour) will be recorded in the pilot's log.

2.5.1.1.3 The quarantine service officer will examine the pilot's log immediately after the craft has landed at the airport. In case of a valid entry of disinsection, compartments (a) will be considered free from quarantine.

2.5.1.1.4 In case there is no record of disinsection in the pilot's log-book, the quarantine officer will proceed as follows :

He will permit all passengers to disembark ; he will close all doors and portholes ; he will proceed to spray compartments (a) with approved

spray equipment, beginning with the toilet, and hand-baggage quarters, proceeding forward towards the crew quarters. Treatment will be at the rate of 1 second per 4 m³ of compartment space. Compartments (a) will remain closed and undisturbed for a period of 5 minutes after treatment; after such time has elapsed, compartments (a) may be declared free from quarantine.

2.5.1.2 *Compartments (b) : not readily accessible during flight.* They include all baggage or freight storage spaces, all under-carriage spaces, and all other parts of the aircraft which are inaccessible during flight, but which could harbour insects.

2.5.1.2.1 Compartments (b) will be treated immediately before the aircraft leaves the last port before arrival at a Sardinian airport. Disinsection of these compartments will be a duty of a regularly assigned crew member. Treatment will take place just before the aircraft leaves the airport or at the time the compartment is being loaded. Treatment may advantageously be undertaken just before the portal is finally closed and sealed for flight. Treatment will be made at a rate of 1 second per 4 m³ of compartment space.

Without exception, empty compartments will be disinsected.

2.5.1.2.2 In case 2 or more Sardinian ports are visited consecutively on the same flight, re-treatment will not be necessary after the first Sardinian port of call.

2.5.1.2.3 Record of treatment time (hour) will be recorded in the pilot's log.

2.5.1.2.4 In case a valid entry of disinsection has been noted in the pilot's log, this compartment (b) of the plane will be considered free from quarantine.

2.5.1.2.5 In case there is no record of disinsection in the pilot's log-book, the quarantine officer will proceed as follows :

Compartment (a) will receive priority treatment. The officer will then open compartments (b) (one portal at a time) and apply insecticide with the equipment available and according to the space requirements of 1 second per 4 m³ for various types of planes. The officer will then completely close compartments (b) and keep them closed for a period of 5 minutes, after which compartments (b) may be declared free from quarantine.

2.5.2 *Intermittent Sardinian service by Italian lines*

2.5.2.1 If the aircraft plies frequently between Sardinia and other Italian ports, all regulations enumerated in section 2.5.1 (including all subsections to 2.5.1.2.5) may apply.

2.5.2.2 When the above-mentioned regulations have been complied with, the plane may be declared free from quarantine.

2.6 Italian international airlines

2.6.1 These aircraft will be treated in accordance with regulations indicated under section 2.5.1, subsections 2.5.1.1.3, 2.5.1.1.4, 2.5.1.2.4, 2.5.1.2.5.

If the pilot's log shows treatment was made in accordance with section 2.5.1 (domestic lines procedure), the plane may be declared free from quarantine.

2.7 Foreign airlines

2.7.1 All foreign aircraft landing at any Sardinian port will be subjected to regulations as indicated in section 2.5.1, subsections 2.5.1.1.3, 2.5.1.1.4, 2.5.1.2.4, 2.5.1.2.5.

2.8 Search for insects : aircraft

Article 1. Search for insects on arriving aircraft will be made as follows :

Article 1.1. All search for insects will be made after disinsection or after complete compliance with quarantine regulations. Flashlight and catching tubes will be used.

Article 1.2. Regular service airlines will have aircraft inspected for insects once each week—but not on the same day of succeeding weeks—as follows :

Immediately after quarantine clearance, a search for insects (alive and dead) will be made. All ports and doors will then be closed and the aircraft will be treated as described for a foreign aircraft under section 2.7. Five minutes after treatment, the aircraft will be again searched intensively for insects (dead or alive). This procedure applies to both compartments (a) and compartments (b) of the aircraft.

Article 1.3. Intermittent service : international service and foreign service aircraft will be inspected for insects at the first port of call each time they arrive in Sardinia.

Article 2. In case insects are found (dead or alive), the number captured will be noted on the sample bottle provided and entered on the relevant form.

The sample bottle will be dispatched immediately to the designated entomological station for inspection.

3. Quarantine Service : Supplies and Equipment

3.1 For aircraft disinsection

3.1.1 The basis of the quarantine service for aeroplane disinsection is the pyrethrum aerosol bomb.

A supply of 6 aerosol bombs (capacity 0.5 kg.) must be stocked.

3.1.2 In instances where aerosol bombs are not available, disinsection will be made with an ordinary hand spray-gun.

Equipment for disinsection by this method must be stocked as follows :

Hand spray-gun	1
Pyrethrum concentrate	500 ml.
Water-white kerosene	10 litres
Funnel—to fit hand spray-gun . .	1
Graduate, 10 ml.	1
Graduate, 200 ml.	1
Litre bottle (dark colour)	1

Other equipment to be stocked :

Flashlight.	1
Catching tubes	6
Sample bottles	6
Extra batteries	—

3.1.3 Insecticide will be prepared in the following prescribed manner :

Ten (10) ml. of pyrethrum concentrate will be measured in the 10 ml. graduate. This will be poured into the large (200 ml.) graduate. A small quantity of kerosene will be used to rinse the small graduate. This will be poured into the large graduate. The large graduate will be filled with kerosene to the 200-ml. mark. Pour contents into dark-coloured litre bottle ; shake the contents of the bottle until thoroughly mixed. Use in hand spray-gun as needed. Store in cool, shady place.

3.2 For surface-craft disinsection

3.2.1 The basic supplies needed for the quarantine service for surface-craft disinsection and for insect inspection (Class I and Class II ports) are as follows:

<i>Insecticides</i>	<i>Class I</i>	<i>Class II</i>
Insecticide canisters	100	10
Aerosol bombs	25	5
5% DDT in kerosene	400 litres	200 litres
Pyrethrum concentrate	1	1
Water-white kerosene	20	20

Equipment

	<i>Class I</i>	<i>Class II</i>
Shoulder pumps (complete).	6	2
Hand pumps	4	1
Funnel for shoulder pumps	2	1
Funnel to fit hand pump	1	1
Graduate, 100 ml.	1	1
Graduate, 1,000 ml.	1	1

Scouting materials

Flashlights complete	2	1
Capture tubes complete	3	1
Sample bottles	18	6
Flashlight batteries	6	3
Flashlight lamps	2	1

3.2.2 The method of disinsection depends upon the 3 sections into which the ship is divided, i.e. :

3.2.2.1 Section 1 — Bridge and officers' quarters : Treatment recommended : Aerosol bomb spray with pyrethrum. Allow 1 second for each 4 m³ capacity, but never less than 2 seconds.

If aerosol bombs are not available, then hand spray-equipment may be used as indicated in section 3.1.2.

If neither the aerosol bomb nor hand spray-equipment (pyrethrum) is available, or if the quarantine officer is of the opinion that residual-spray treatment is more desirable, then either shoulder pumps, using a prescribed residual insecticide, or insecticide smoke canisters may be used.

3.2.2.2 Section 2 — Crew's quarters and smaller rooms, bunks, rest rooms, toilets, etc. : The same regulations as enumerated under 3.2.2.1.

3.2.2.3 Section 3 — Holds :

3.2.2.3.1 Vessels under 200 tons capacity : see section 1.3, Article 1.3.1.

3.2.2.3.2 Vessels over 200 tons : Insecticide canisters or fog-producing candles will be used to disinsect holds of all vessels exceeding 200 tons.

Since various types of canisters exist and since procedure in use may differ from type to type, it will be necessary to acquaint the quarantine official with the use of the type supplied to the said official.

4. Sanitation of Areas Adjacent to Surface-craft Ports and Airports

4.1 For all airports

All human and animal habitations within a 3-kilometre radius of said airport will be treated with a residual spray containing not less than 5% of DDT or other insecticide as may be prescribed.

Treatment will be carried out according to regulations enforced by ERLAAS. Treatment will be made twice yearly as follows : first treatment commencing not before 1 December, finishing not after 31 December ; second treatment commencing not before 1 May finishing not after 1 June.

Treatment will be organized and executed by the head of the quarantine service at the airport in question.

4.2 For all surface-craft ports

4.2.1 For Class I ports

All animal habitations or shelters within a radius of 1,000 metres of the port dock area (inside the breakwater) will be treated with a residual spray containing not less than 5% of DDT, or other insecticide, as may be prescribed.

4.2.2 For Class II ports

All animal habitations or shelters within a radius of 3,000 metres of the port dock area (inside the breakwater) will be treated with a residual spray containing not less than 5% of DDT, or other insecticide, as may be prescribed.

Treatment will be organized and executed by the head of the quarantine service at the port in question.

ERLAAS**QUARANTINE SERVICE****CERTIFICATE OF DISINSECTION OF SURFACE CRAFT**

Date

It is hereby certified that the seacraft (brick, barge, motorboat, steamer, etc.) registering tons has been inspected and disinfected at the date mentioned above in the Port of

Disinfection has been carried out as follows :

- (1) Bridge and officers' quarters were treated by
.....
- (2) Crew's quarters and small rooms treated by
.....
- (3) Holds treated by

The validity of this certificate is as follows, for (1), (2), (3).

NOTES

.....

.....

Signed

(1), (2), (3) Must be re-treated at every port of arrival in Sardinia unless she has been treated with residual spraying.

QUARANTINE SERVICE**NOTIFICATION OF ARRIVAL OF AIRCRAFT**

Name and number of aircraft

Date of announced arrival

Hour

Line

Hour of expected arrival

Notification transmitted to quarantine service officer

By messenger (hour)

By telephone (hour)

Notification received by quarantine service officer

By messenger (hour)

If notification was
effected by means
other than by
messenger, time of
arrival of the
quarantine service
officer at duty
station (hour)



BULLETIN OF THE WORLD HEALTH ORGANIZATION

The *Bulletin of the World Health Organization* is the principal scientific organ of WHO and is the successor to the *Bulletin mensuel de l'Office International d'Hygiène Publique* and the *Bulletin of the Health Organization of the League of Nations*. It contains original articles either in English or in French, with summaries in both languages, on scientific and public-health subjects of international significance, and bibliographical data.

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